Manuscript Report No. 88-14

The effects of commercial fishing on lake sturgeon (*Acipenser fulvescens*) populations in the Sipiwesk Lake area of the Nelson River, Manitoba, 1987 - 1988.

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Manitoba
Natural Resources
Fisheries

90-02594/

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ABSTRACT

The exploitation of lake sturgeon (Acipenser fulvescens) populations in the Nelson River by the commercial fishery since the turn of the century was characterized by periods of intensive fishing, each followed by collapse of the populations and temporary closure of the fishery. Since the fishery last reopened in 1970, commercial production has remained relatively stable due to reduced catch quotas.

In order to evaluate the effects of the present management regulations on the sturgeon populations in the Sipiwesk Lake area of the Nelson River, a total of 190 fish were sampled from the commercial catch in 1987 and 1988. Age frequency distributions and growth rates were compared to similar studies carried out in the past. A critical review of these studies is presented.

The present age structure of the population shows a high proportion of older individuals and a mean age of 35.8 years. It is similar to the population age structure in the years 1953 and 1954 when overexploitation had not yet started to show its effects. The growth rate of the present populations is faster than in the 1950's probably due to smaller population size.

Several recommendations for the future management and monitoring of the Nelson River sturgeon fishery are presented.

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INTRODUCTION

The rapid decline of the lake sturgeon (Acipenser fulvescens) populations in North America since the turn of the century has been extensively documented in the literature (Brousseau 1987, Dumont et al, 1987, Harkness and Dymond 1961, Mosindy 1987). Most authors blame overfishing and inadequate commercial harvest regulations as the major factors contributing to this decline.

The history of the commercial sturgeon fishery in Manitoba is yet another example of how poorly controlled exploitation of a resource can lead to its almost complete destruction. Prior to 1900, practically all of the commercial harvest of sturgeon in Manitoba was taken from Lake Winnipeg (Harkness 1980). This harvest peaked at 445,000 kg in 1900 and then started to decline rapidly despite increasing fishing effort. When the harvest dropped to 13,700 kg in 1910, alarmed authorities closed the fishery. Nevertheless, the lake sturgeon populations of Lake Winnipeg have not recovered ever since.
The collapse of the Lake Winnipeg sturgeon fishery, as well as the increasing demand and value of sturgeon (the price of one pound of sturgeon rose from 10 cents in 1916 to 50 cents in 1923 (Harkness 1980)), directed more attention to northern Manitoba as a potential area for the commercial production of sturgeon, soon after the Manitoba sturgeon fishery was reopened in 1916 after a five year closure, the upper Nelson River became one of the major targets. In 1917, 57% of the total Manitoba production of 119,000 kg was harvested from the Nelson

River (Harkness 1980). The intensive fishing and high yields continued until 1924, but soon afterwards the Nelson River sturgeon fishery collapsed and was closed (Fig. 1).

The subsequent history of the Nelson River fishery shows two more periods of exploitation, each of which was followed by collapse and closure (Fig. 1). Every time the fishery was reopened, attempts were made to regulate the fishery more closely by lowering the catch quota (Table 1). Nevertheless, the collapse of the fishery in 1946 and again in the 1960 showed that much more stringent regulations were required in order to ensure a sustained yield.

When the Nelson River sturgeon fishery reopened in 1970 after a nine year closure, the new management regulations lowered the total annual catch quota to 7711 kg of dressed weight and increased the legal mesh size to 330 mm. In addition, five management zones were created, each with its own catch quota (Fig. 2, Table 2). Since only two of the five zones are fished consistently each year, the total production of the Nelson River sturgeon averaged only 3232 kg per year, or 41% of the total allowed quota in the past 18 years (Table 2).

In order to evaluate the effects of the present management regulations on the lake sturgeon populations of the Nelson River and to provide a data base for the future assessment of impacts by hydroelectric development, a program of annual sampling of the commerical catch in Sipiwesk Lake was initiated in 1987 by the Manitoba Department of Natural Resources. This report summarizes the data collected during the first two years of the program and compares the present findings to two previous studies (Sunde 1961 and Sopuck 1987).

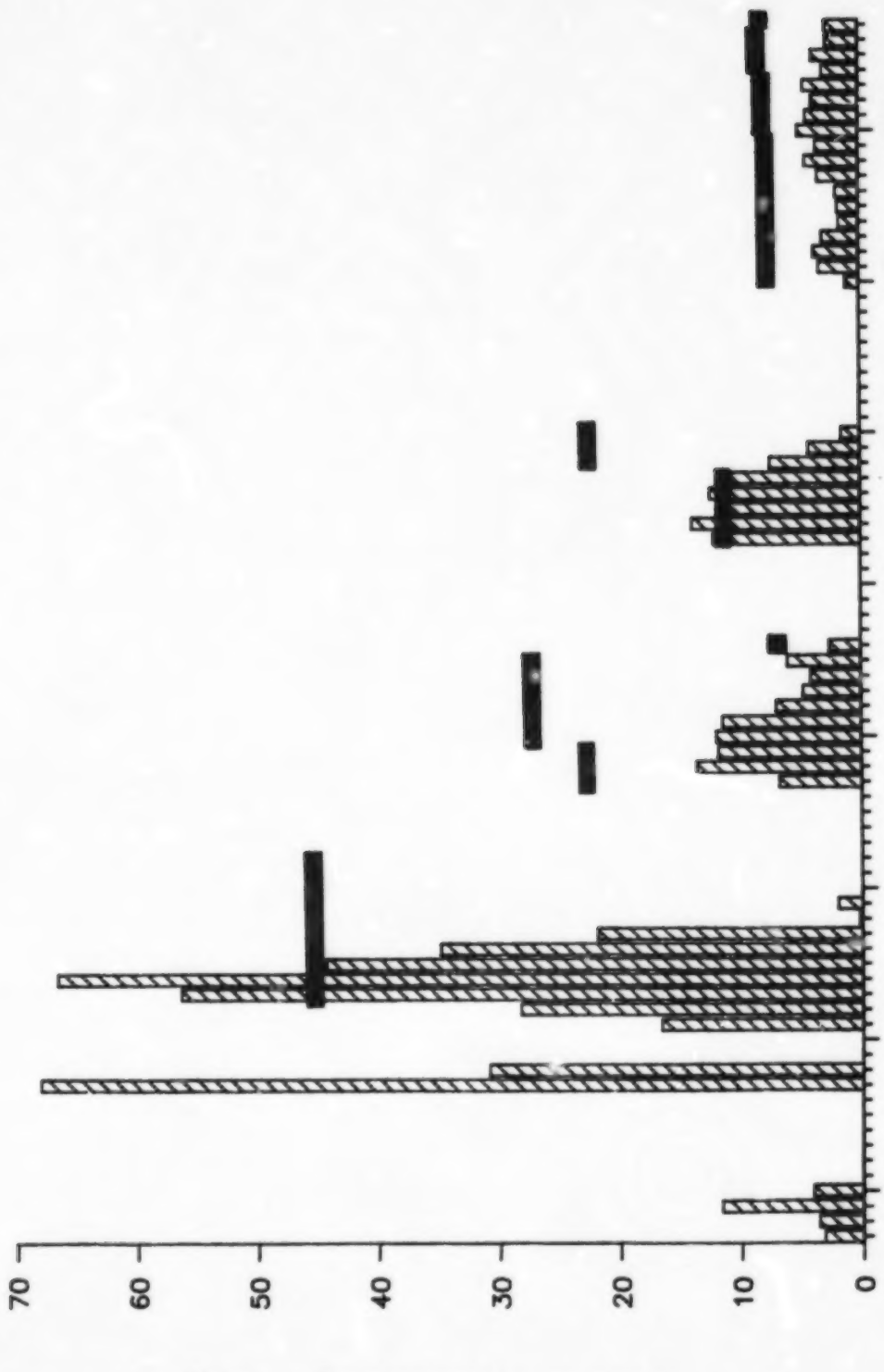

Fig. 1. Production of lake sturgeon from the Nelson River commercial fishery, 1907 to 1987. The horizontal bars show catch quotas imposed by the management regulations. The fishery was closed four times : 1911 to 1915, 1933 to 1936, 1947 to 1952 and 1961 to 1969.

Table 1. Management regulations for the Nelson River commercial sturgeon fishery, 1923 to 1988.

Year		Annual Quota (kg)	Minimum Mesh Size (mm)	Fishing Season
1923 - 1927		45359	279	June 1 - Oct 15
1928 - 1932		45359	305	Nov 10 - Feb 28
1933 - 1936	CLOSED			
1937 - 1939		22680	305	June 15 - Aug 15
1940 - 1945		27216	305	June 15 - Aug 15
1946		6804	305	July 2 - Sept 28
1947 - 1952	CLOSED			
1953 - 1957		11340	305	June 10 - Aug 8
1958 - 1960		22680	305	June 10 - Aug 8
1961 - 1969	CLOSED			
1970 - 1979		7711 *	330	June 15 - Oct 31
1980 - 1983		8000 *	330	June 15 - Oct 31
1984 - 1986		8416 *	330	June 15 - Oct 31
1987 - 1988		8226 *	330	June 15 - Oct 31

* combined annual quota from five separate management zone quotas (see Table 2 and Fig. 2).

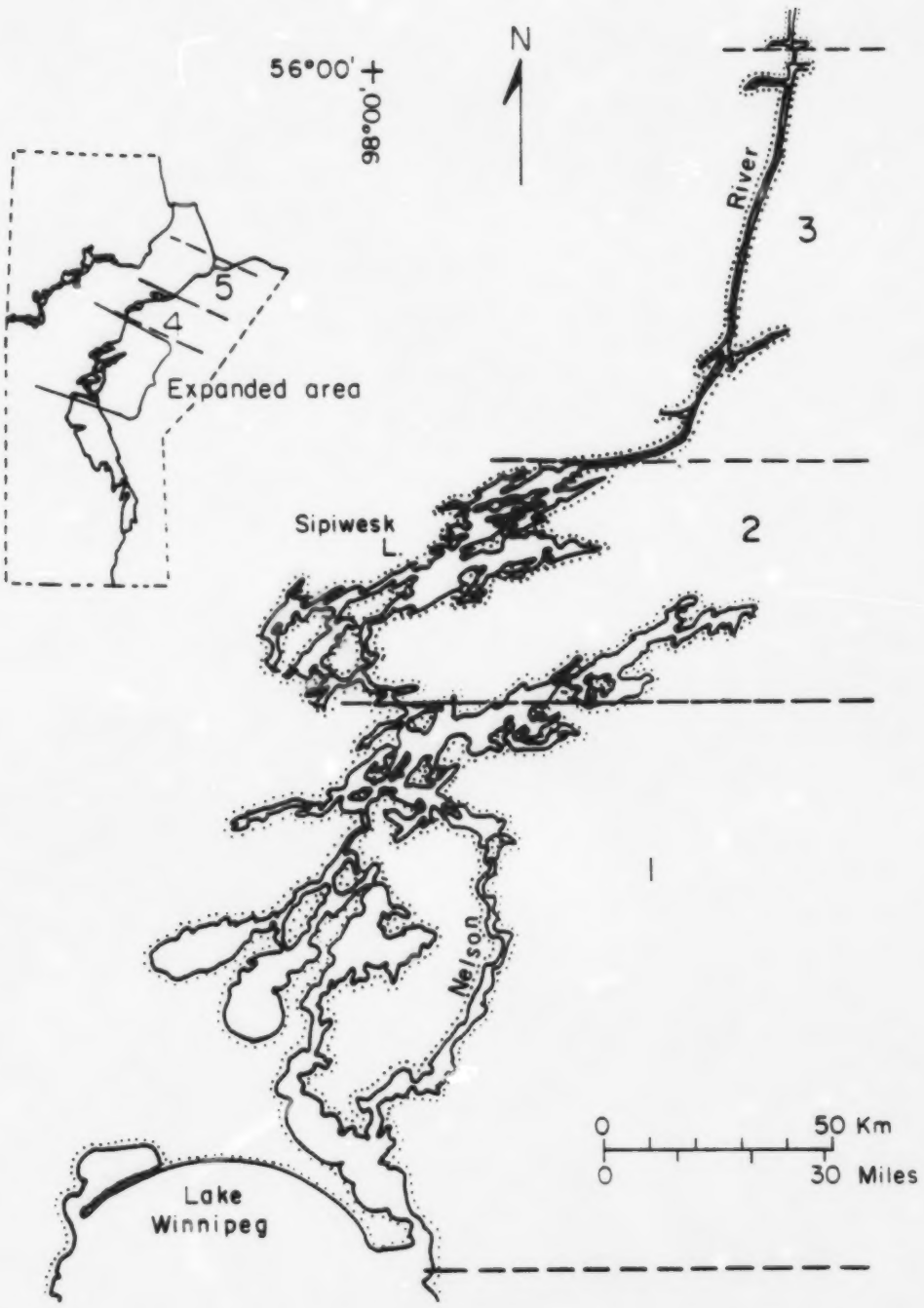

Fig. 2. The management zones for the upper Nelson River commercial sturgeon fishery. Inset shows two additional management zones on the lower Nelson River.

Table 2. Commercial production of lake sturgeon in each management zone of the Nelson River, 1970-1987. Production is given as marketed weight (kg) and as a percentage of the annual zone catch quota# taken in each zone.

Year	Zone #1		Zone #2		Zone #3		Zone #4		Zone #5		Total	
	(kg)	(%)	(kg)	(%)	(kg)	(%)	(kg)	(%)	(kg)	(%)	(kg)	(%)
1970	190	8	472	26	355	26	110	8	0	0	1127	15
1971	168	7	1403	77	1052	77	165	12	566	62	3354	43
1972	0	0	2100	116	1575	116	0	0	115	13	3790	49
1973	0	0	1493	82	1191	88	389	29	0	0	3073	40
1974	0	0	576	32	844	62	219	16	0	0	1639	21
1975	0	0	241	13	1527	112	0	0	0	0	1768	23
1976	31	1	429	24	1465	108	0	0	0	0	1925	25
1977	10	0	1322	73	1138	84	945	69	0	0	3415	44
1978	274	12	1909	105	1490	109	782	57	0	0	4455	58
1979	698	31	655	36	1488	109	466	34	227	25	3534	46
1980	904	39	1646	87	1648	118	824	59	0	0	5021	63
1981	314	14	1998	105	1401	100	155	11	500	50	4368	55
1982	66	3	1720	91	1171	84	251	18	700	70	3908	49
1983	51	2	2271	120	2221	159	0	0	0	0	4543	57
1984	0	0	1605	84	1391	77	0	0	0	0	2996	36
1985	279	12	1888	99	1689	93	0	0	0	0	3856	46
1986	162	7	1572	83	932	51	0	0	0	0	2666	32
1987	211	9	1439	84	1079	59	0	0	0	0	2729	33
1970-1987												
Total	3359		24739		23656		4305		2108		58168	
Mean	187	8	1374	74	1314	91	239	17	117	12	3232	41

the annual zone catch quotas (dressed weight) were assigned as follows:
Zone #1: 2268 kg in 1970-1979; 2300 kg since 1980
Zone #2: 1814 kg in 1970-1979; 1900 kg in 1980-1986; 1710 kg since 1987
Zone #3: 1361 kg in 1970-1979; 1400 kg in 1980-1983; 1816 kg since 1984
Zone #4: 1361 kg in 1970-1979; 1400 kg since 1980
Zone #5: 907 kg in 1970-1979; 1000 kg since 1980

METHODS AND MATERIALS

The sturgeon sampling program was conducted from June 17 to 30 in 1987 and from June 17 to July 2 in 1988. The fish were obtained from catches of commercial fishermen who fished in the eastern half of Sipiwesk Lake (Nelson River management zone #2; Fig. 2). All the fish were caught in gillnets of 330 mm mesh size (stretched measure).

Data taken from each fish included round weight, fork length[1], sex and maturity. In addition, part of the left pectoral fin rays was collected for aging purposes. The fin rays were removed with a hack saw and were cut as close as possible to the point of articulation with the body wall. The fin rays were dried for at least three weeks and then cross-sectioned approximately 1.5 mm from the base using a 0.3 mm thick diamond edge wafering saw blade on an Isomet 11-1180 low speed saw. Two sections of approximately 0.5 mm thickness were taken, cleaned in water and mounted on a microscope slide using a Shandon-Mount solution. The annuli were counted on a Data View LF 1015 microfiche reader, according to procedures outlined by Cuerrier (1951).

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1. In 1988 only total lengths were taken; however, they were subsequently converted to fork lengths by using the regression equation, Fl = 0.9205 TL + 8.79 mm. This regression (r = 0.991) was derived from the 1978 data compiled by Sopuck (1987).

RESULTS

Totals of 80 and 110 sturgeon were sampled in 1987 and 1988, respectively. This sample comprised approximately half of all the sturgeon caught in Sipiwesk Lake in both years.

The age frequency distribution (Fig. 3) shows little difference between the two years. In 1987, the ages ranged from 12 to 87 years with a mean of 36.1 years, while in 1988 they ranged from 13 to 76 years with a mean of 35.6 years (Appendices 1 and 2). This similarity between the two years is also reflected in the size distribution of the sampled fish (Figs. 4 and 5). In 1987, the sturgeon averaged 1225 mm in fork length and 16066 g in weight, while in 1988 they averaged 1250 and 16253 g (Tables 3 and 4).

The length–weight relationship for sexes combined shows no significant difference between the two years and indicated that the sturgeon grow isometrically (Fig. 6). The mean condition factor[1] for sexes combined was 0.84 in 1987 and 0.82 in 1988.

The age-specific fork lengths of sturgeon show great variability in the size of individual fish in each age class (Fig. 7). Due to the small sample sizes for each age (Tables 3 and 4), the fish were grouped in age intervals of three years each. The calculated mean fork lengths for each age interval indicate that beyond the age of 20 years, sturgeon growth seems to be linear and at the rate of

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1. Condition factor = Weight (g) x 10^5 / fork length (mm).

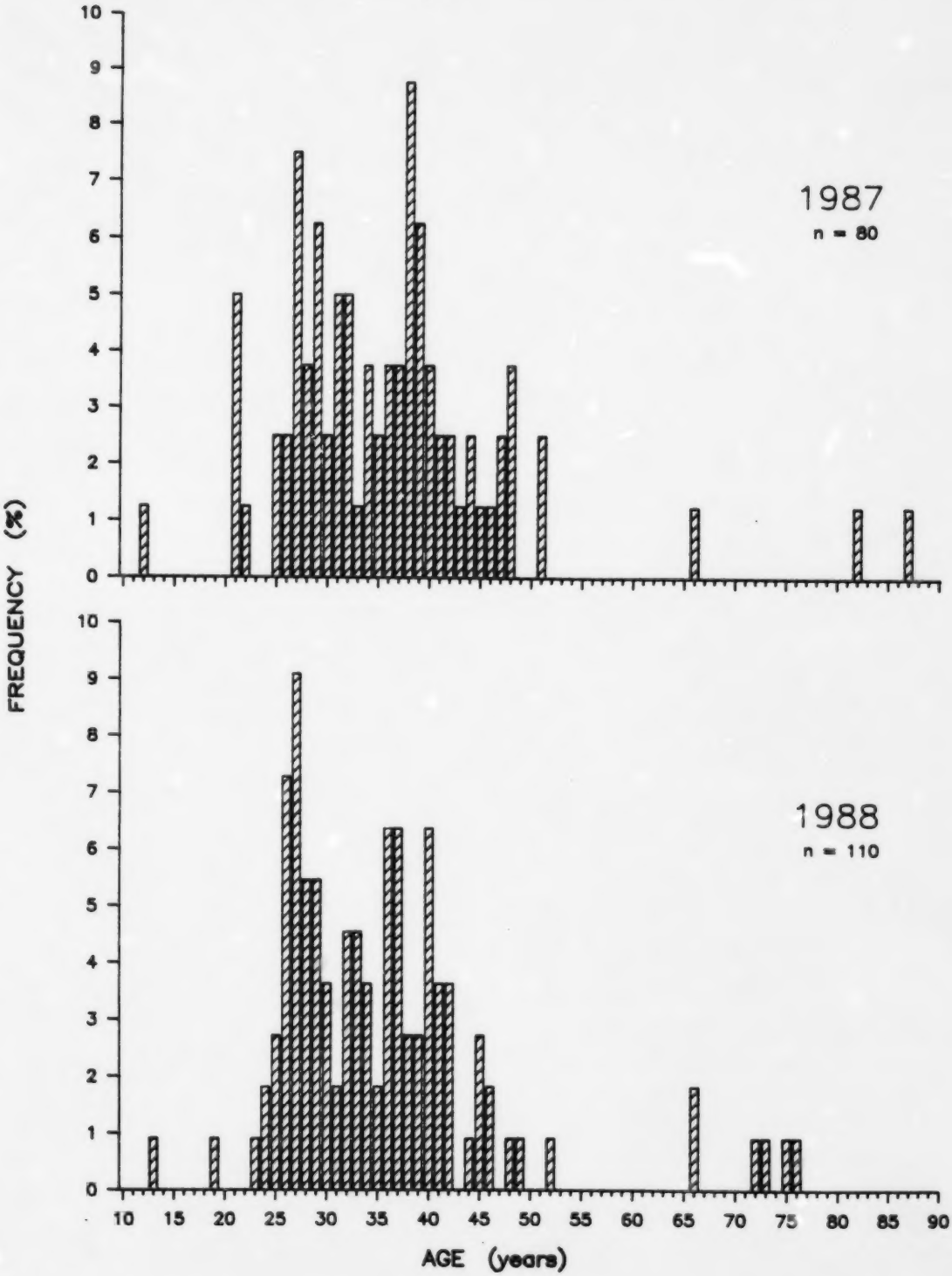

Fig. 3. Age frequency distribution of sturgeon sampled from the Sipiwesk Lake commercial fishery in 1987 and 1988.

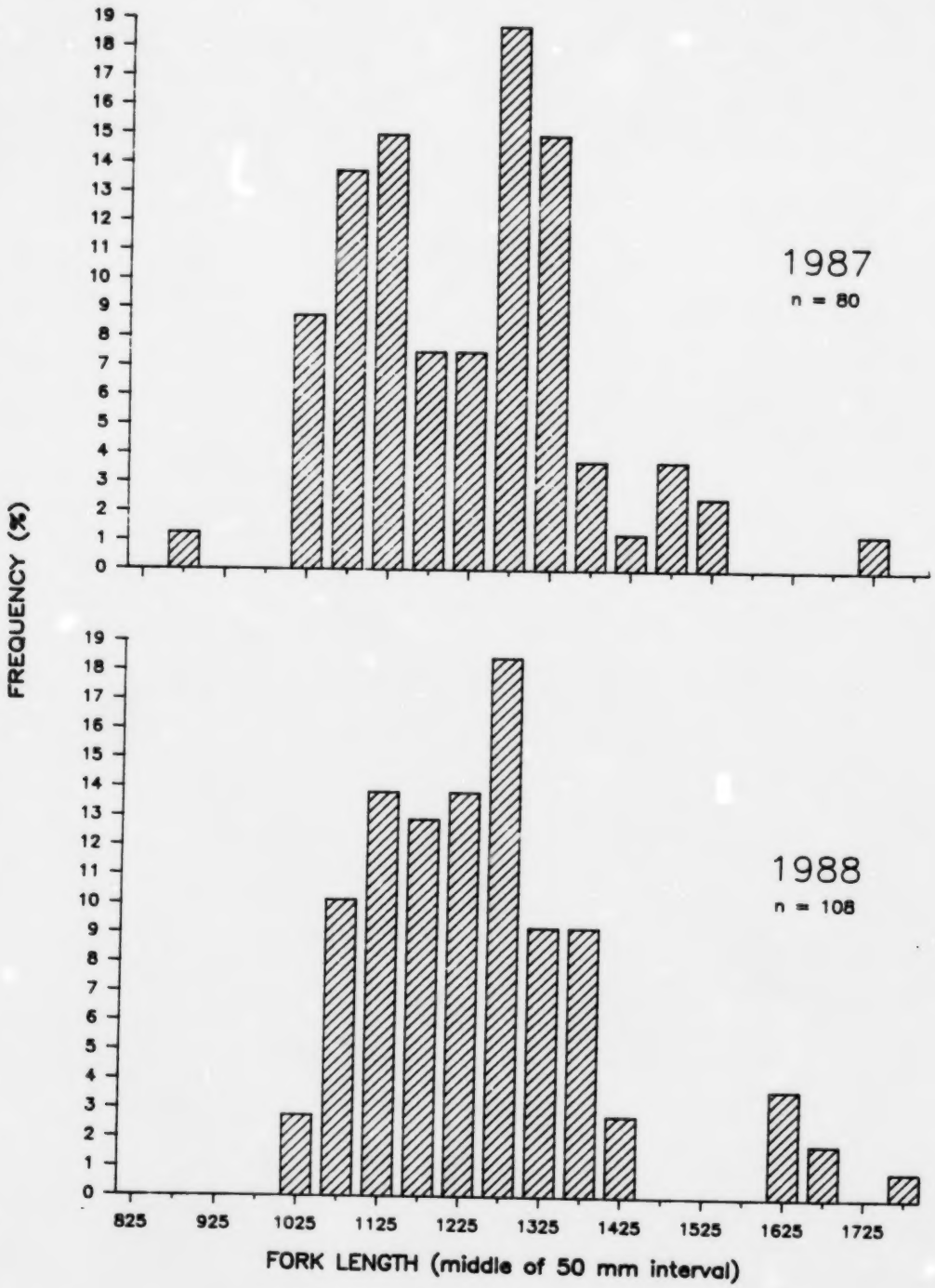

Fig. 4. Fork length frequency distribution of sturgeon sampled from the Sipiwesk Lake commercial fishery in 1987 and 1988.

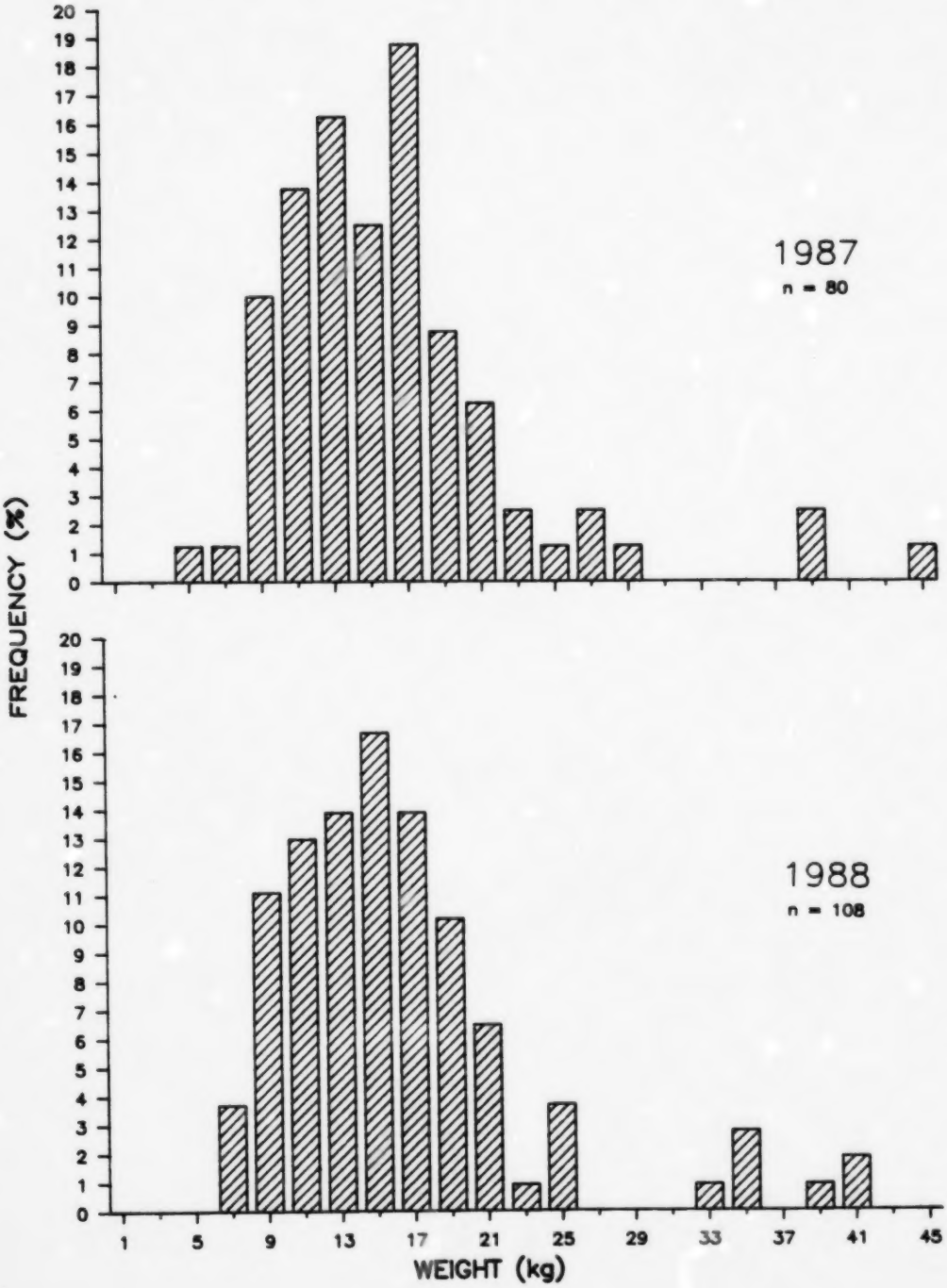

Fig. 5. Weight frequency distribution of sturgeon sampled from the Sipiwesk Lake commercial fishery in 1987 and 1988.

Table 3. Age-specific mean size of sturgeon caught by commercial fishermen in Sipiwesk Lake in 1987.

Age (years)	n	Round Weight (g) Mean	Round Weight (g) STD*	Fork Length (mm) Mean	Fork Length (mm) STD*
12	1	5740		860	
21	4	10713	2504	1088	95
22	1	12470		1150	
25	2	10763	2386	1095	92
26	2	14405	5367	1185	120
27	6	12088	2399	1097	71
28	3	11113	3455	1078	16
29	5	11817	2975	1125	71
30	2	14003	2436	1108	110
31	4	13553	2490	1159	69
32	4	13756	4414	1198	96
33	1	15550		1200	
34	3	12395	5550	1162	121
35	2	12138	5038	1188	145
36	3	15250	3274	1272	152
37	3	17550	2362	1260	61
38	7	16066	3106	1264	84
39	5	18609	2720	1327	49
40	3	16933	645	1303	12
41	2	24780	6322	1393	110
42	2	13588	4154	1208	95
43	1	22550		1310	
44	2	16013	2139	1323	39
45	1	17275		1270	
46	1	25550		1500	
47	2	19688	1149	1303	39
48	3	23517	5864	1385	115
51	2	16413	5215	1228	117
66	1	38215		1535	
82	1	45000		1540	
87	1	39850		1730	
Total	80	16066	6844	1225	146

* standard deviation

Table 4. Age-specific mean size of sturgeon caught by commercial fishermen in Sipiwesk Lake in 1988.

Age (years)	n	Round Weight (g) Mean	Round Weight (g) STD*	Fork Length (mm) Mean	Fork Length (mm) STD*
13	1	9500		1040	
19	1	10700		1150	
23	1	8400		1031	
24	2	14200	1697	1178	0
25	3	9667	551	1073	43
26	8	12013	3915	1165	93
27	10	12150	3151	1168	85
28	6	16233	4852	1215	114
29	6	13350	3951	1212	93
30	4	13725	2647	1123	36
31	2	12500	1838	1136	59
32	4	13850	3279	1235	73
33	5	15300	4059	1250	108
34	3	14000	6465	1242	169
35	2	15150	2899	1247	33
36	7	15571	3470	1244	88
37	7	17229	3640	1286	77
38	3	13200	5551	1202	152
39	3	19333	2450	1310	74
40	7	17593	3924	1279	72
41	4	17250	2453	1263	66
42	4	18775	4571	1314	92
44	1	12200		1178	
45	3	21133	10366	1377	202
46	2	15400	1556	1307	104
48	1	15400		1297	
49	1	25800		1408	
52	1	24200		1380	
66	2	34750	354	1638	13
72	1	38900		1767	
73	1	34100		1675	
75	1	40200		1601	
76	1	41200		1666	
Total	108	16253	6856	1250	147

* standard deviation

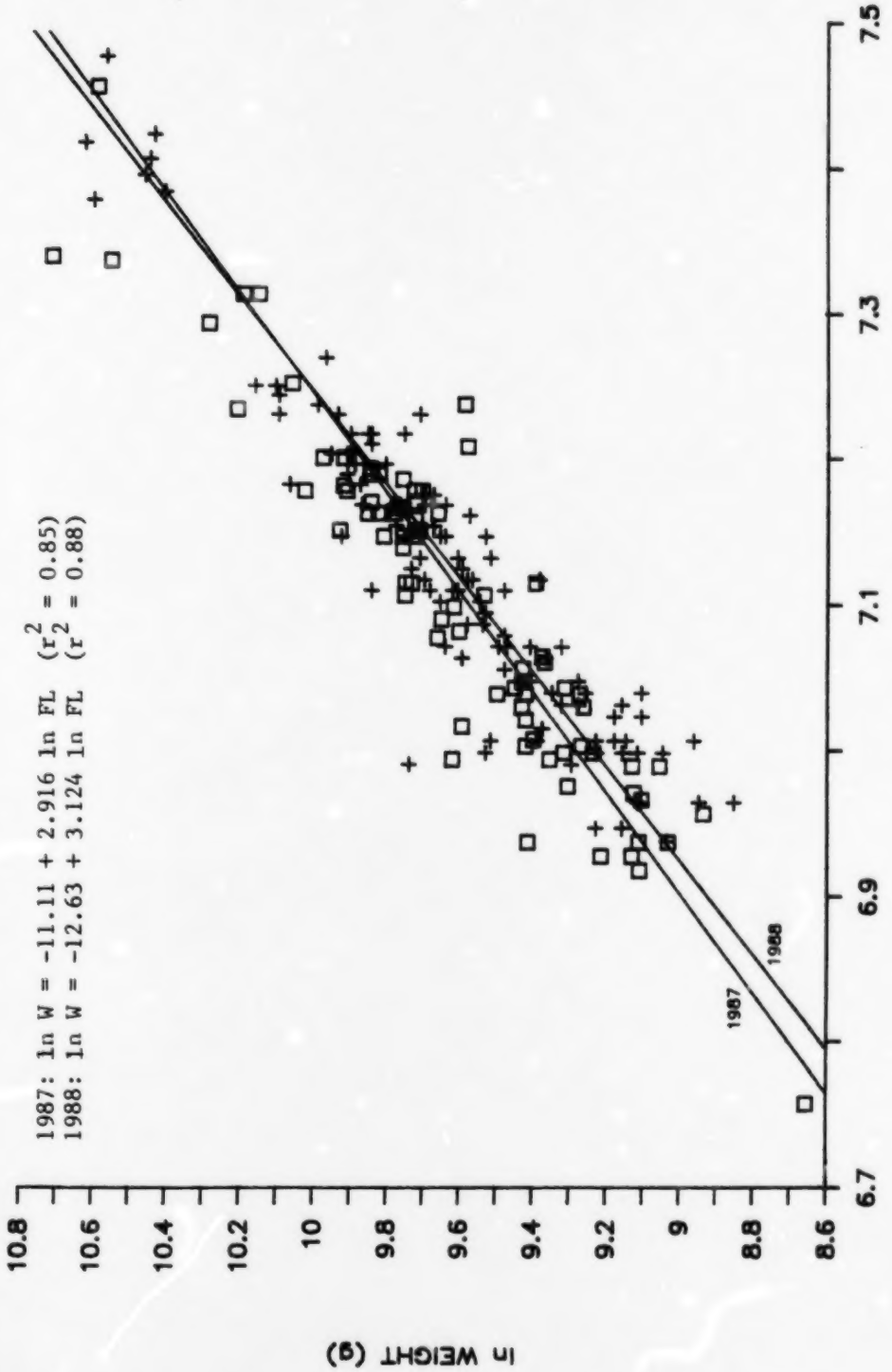

Fig. 6. Length - weight relationship based on individual sturgeon sampled from the Sipiwesk Lake commercial fishery in 1987 (squares) and 1988 (crosses).

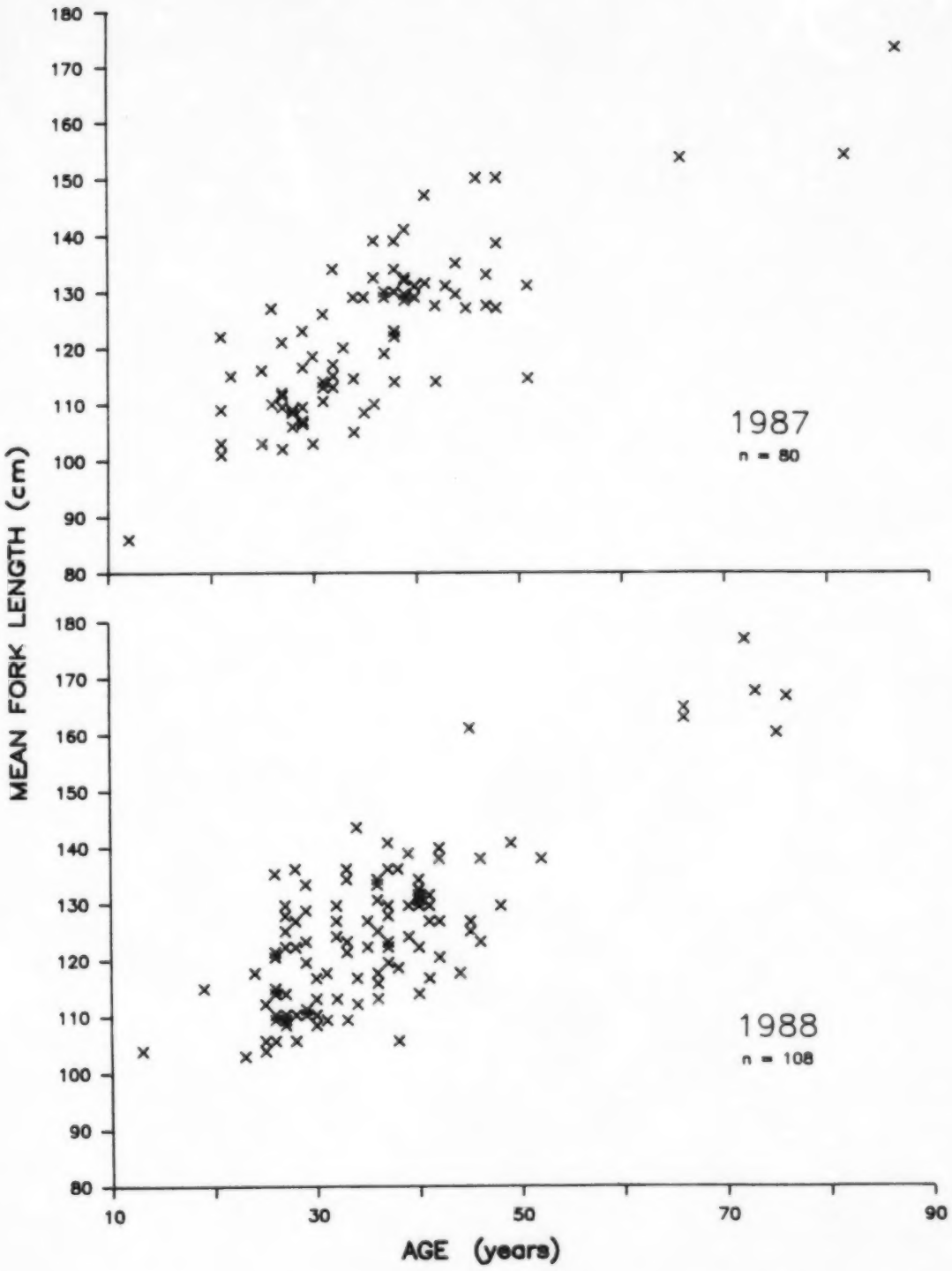

Fig. 7. Age-specific fork lengths for all sturgeon sampled from the Sipiwesk Lake commercial fishery in 1987 and 1988.

approximately 10 mm per year (Fig. 8). This apparent lack of asymptotic size in Nelson River sturgeon was also reported by Sunde (1961).

One of the fish sampled in 1988 had been previously tagged in May 1977. Aged 40 years old in 1988, this fish grew from 1092 mm to 1225 mm in fork length and from 10430 g to 16050 g in weight, during the 11-year period. This growth is very similar to the average rate of growth determined for the Nelson River sturgeon in 1987 and 1988.

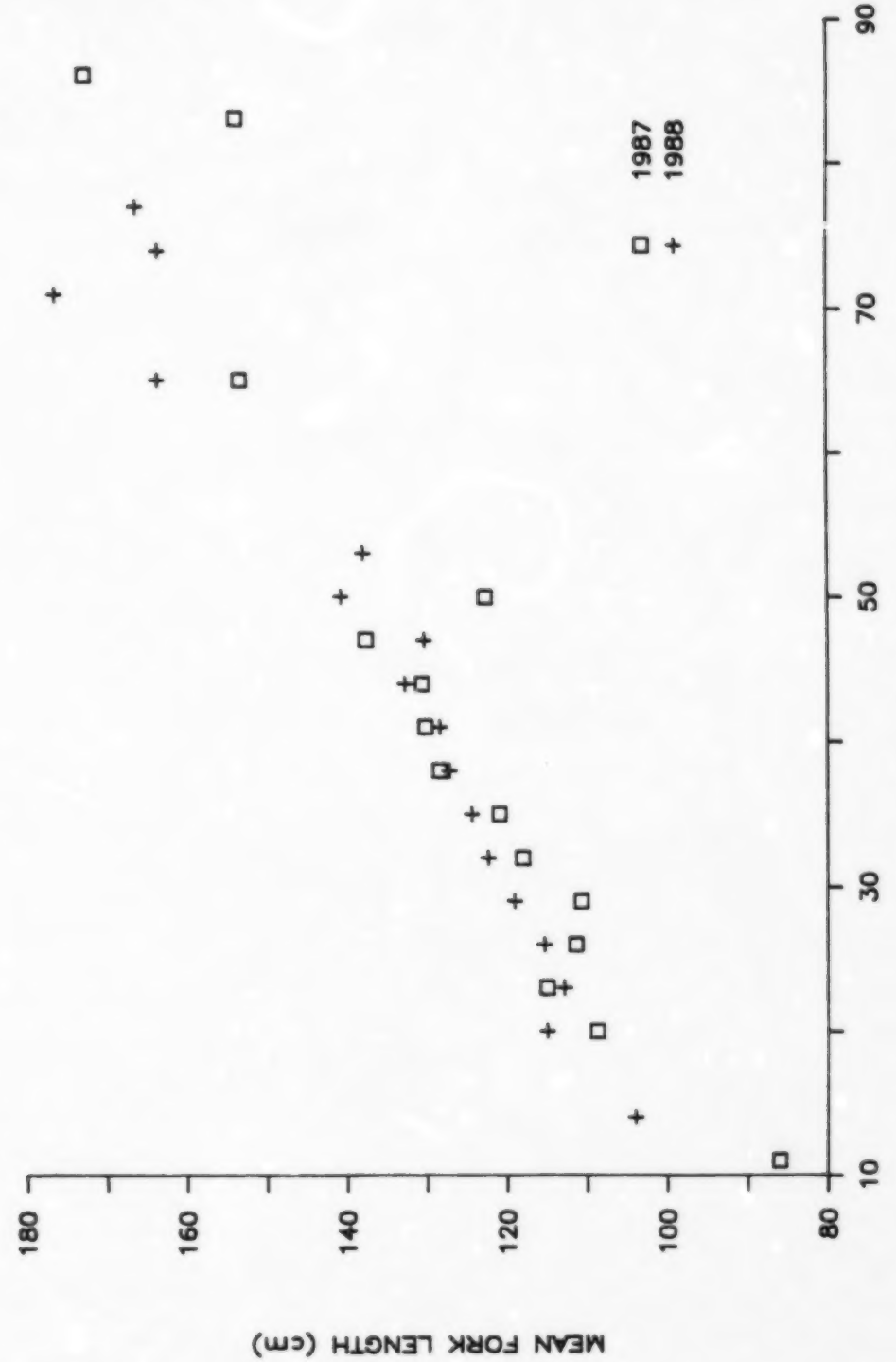

Fig. 8. Mean age-specific fork lengths of sturgeon in Sipiwesk Lake, 1987 and 1988.

DISCUSSION

Age Frequency Distributions

The age frequency distributions of sturgeon caught by the Nelson River commercial fishery between 1954 and 1959 showed a progressive shift towards younger ages (Sunde 1961). The proportion of sturgeon under 25 years old increased from 6% of the total catch in 1954 to 37% of the catch in 1959 (Fig. 9). Similarily, the mean age of the catch dropped from 40.7 to 30.6 years in the same period (Sunde 1961). This drastic change in the population age structure was interpreted by Sunde (1961) to be one of the main symptoms of a population on the verge of collapse.

The comparison of the age frequency distribution of the Nelson River sturgeon in 1987 and 1988 to the data from Sunde (1961) shows more similarity to 1953 and 1954, than to the second half of the 1950's, when overfishing started to show its effects (Fig. 9). The low proportion of fish under 25 years old in the total catch (6.3% in 1987 and 4.5% in 1988) and the high mean age of the catch (36.1 years in 1987 and 35.6 years in 1988) suggest that the population age structure may be relatively well balanced at the present time.

In his study of the Nelson River sturgeon in 1977 and 1978, Sopuck (1987) presented an age frequency distrubution which approximated that of the late 1950's and he expressed concern that the population might be approaching a collapse. However, a close inspection of Sopuck's (1987) data reveals that 66% of sturgeon in 1978 were caught

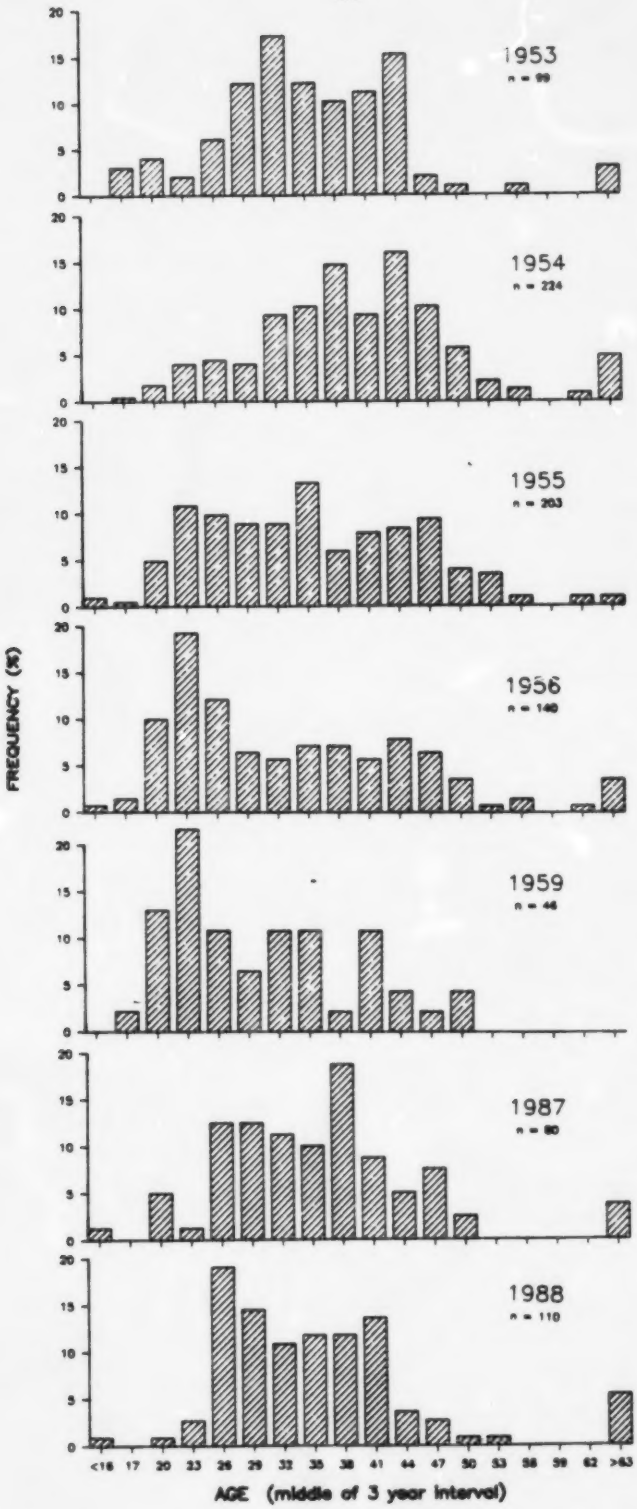

Fig. 9. Age frequency distributions of sturgeon sampled from the Sipiwesk Lake commercial fishery in the 1950's (Sunde 1961) and in 1987 and 1988.

in gillnets of 254 mm mesh size (no mesh size data was given for 1977 other than its range from 254 to 330 mm). As the commercial fishermen in the 1950's used gillnets of at least 305 mm mesh size, gear selectivity has probably created a bias towards younger fish in Sopuck's (1987) data. Furthermore, all the sturgeon in the 1977-1978 study were caught on the spawning grounds during the spawning season. Since male sturgeon spawn at least twice as often as females (Priegel and Wirth 1971) and are more numerous on the spawning grounds than females (Cuerrier 1949), it is reasonable to assume that the sturgeon sample from 1977 and 1978 was biased towards males. In the Nelson River, male sturgeon mature 5 to 10 years earlier than the females (Sunde 1961) and thus would tend to skew the age frequency distribution of the 1977-1978 sample towards younger ages. Any comparison of this sample to the commercial catch data should therefore be treated with caution.

Growth

Because there was no difference between the mean age-specific fork length of sturgeon in 1987 and 1988, the data from these two years were combined. In addition, the present data as well as the data from Sopuck (1987), were grouped into age intervals of three years each in order to allow comparison to the growth data from Sunde (1961), which were grouped in the same manner (Table 5).

Inadequate sample sizes from the very young and the very old fish allow for the comparison of only one section of the growth curve corresponding to fish between 19 and 45 years old. The results indicate

Table 5. Age-specific mean fork lengths (FL) of the Nelson River sturgeon in 1953-1956 (Sunde 1961), 1977-1978 (Sopuck 1987) and 1987-1988.

Age Group (years)	1953-1956		1977-1978		1987-1988	
	n	FL(mm)	n	FL(mm)	n	FL(mm)
1 - 3	1	279				
4 - 6	1	363				
7 - 9	2	632				
10 - 12					1	860
13 - 15	1	691	1	970	1	1040
16 - 18	9	978	11	994		
19 - 21	35	989	24	1011	5	1100
22 - 24	67	1057	53	1038	4	1134
25 - 27	59	1104	71	1084	31	1141
28 - 30	56	1088	54	1148	26	1159
31 - 33	69	1136	29	1201	21	1204
34 - 36	84	1164	16	1209	21	1230
37 - 39	72	1166	12	1291	28	1279
40 - 42	61	1195	6	1306	22	1290
43 - 45	84	1199	2	1383	8	1317
46 - 48	53	1247	2	1358	9	1352
49 - 51	28	1277			3	1288
52 - 54	15	1270			1	1380
55 - 57	8	1261	2	1430		
58 - 60						
61 - 63	5	1412				
64 - 66	8	1427			3	1604
67 - 69	3	1339				
70 - 72	2	1422	1	1486	1	1767
73 - 75	2	1410			2	1638
76 - 78					1	1666
79 - 81						
82 - 84	4	1600			1	1540
85 - 87	1	1537			1	1730
88 - 90	1	1651				
91 - 93						
94 - 96						
97 - 99	1	1499				
100-102	1	1753				
103-105	1	1702				
106-108						
109-111	1	1600				

that sturgeon fork lengths-at-age were consistently larger in 1987-1988 than in 1953-1956 (Fig. 10). The 1977-1978 data approximates that of 1953-1956 for ages less than 28, but is very similar to 1987-1988 for older fish.

It is possible that the shift towards faster growth is the result of overfishing by the commercial fishery in the 1950's. Assuming that food availability is the main factor limiting sturgeon growth, the drastic depletion of the population would tend to reduce intra-specific competition for food and thus promote faster growth exhibited by the sturgeon today.

Comparison of the length-weight relationship and the mean condition factors for the 1953-1956, 1977-1978 and 1987-1988 periods shows very little change between the three periods (Table 6).

Weight Frequency Distributions

Sunde (1961) reported that the average round weight of sturgeon in the commercial catch dropped from 14.4 kg to 12.5 kg between 1953 and 1959. In comparison, the mean round weight of the sampled sturgeon was 16.1 kg in 1987 and 16.3 kg in 1988 (Tables 3 and 4). This increase in the average weight is partially due to the increase in the mesh size used in the commercial fishery (from 305 mm in the 1950's to 330 mm today). However, it is also a reflection of the higher proportion of very large fish in the present day catches. Whereas in the 1950's sturgeon weighing more than 20 kg comprised 10% of the total catch, this proportion increased to 21% presently (Fig. 11). Similar

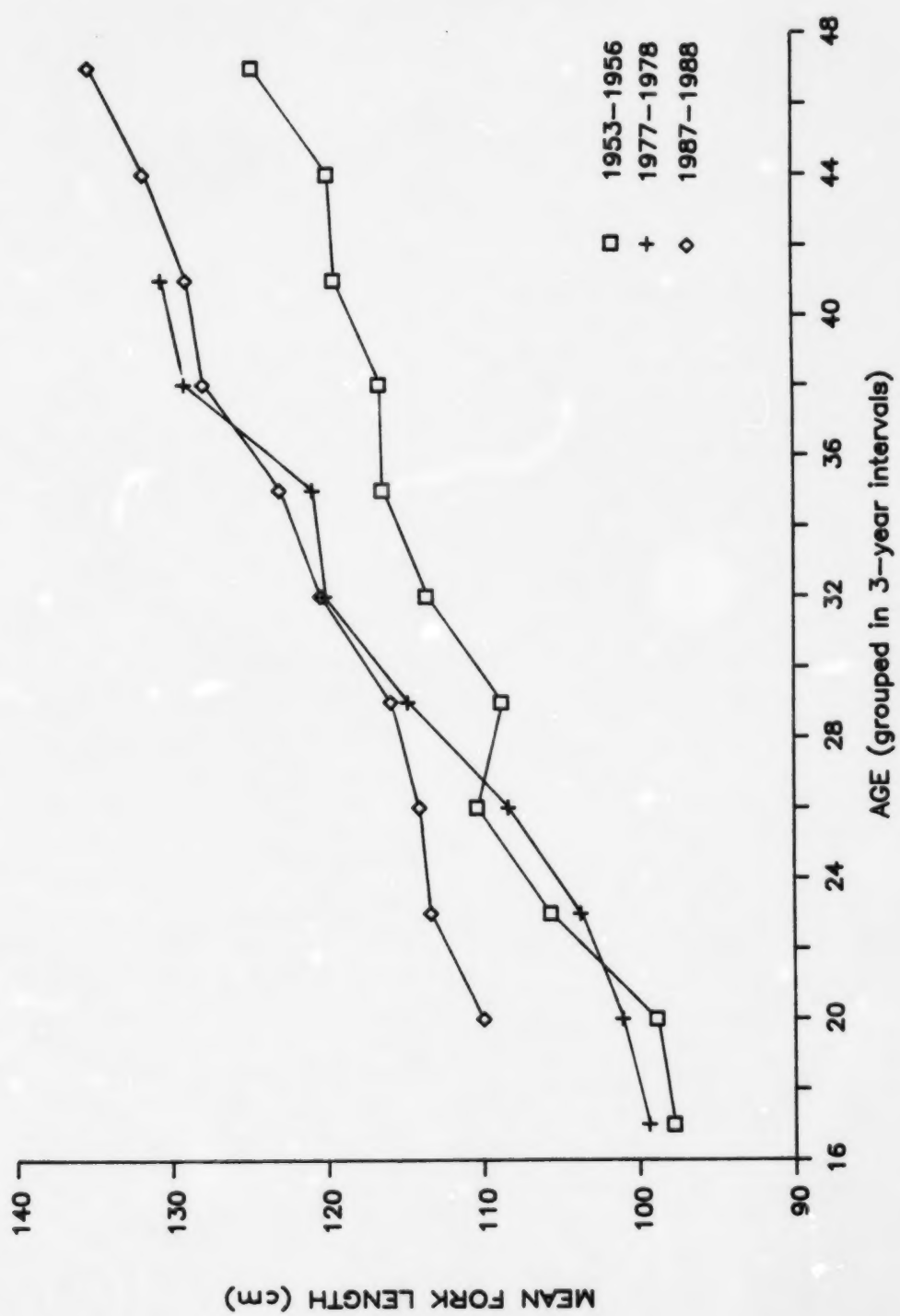

Fig. 10. Comparison of age-specific mean fork lengths for Nelson River sturgeon in 1953 to 1956 (Sunde 1961), 1977 to 1978 (Sopuck 1987), and 1987 to 1988.

Table 6. Comparison of mean size, mean age, mean condition factor, length-weight relationship, and growth rate of the Nelson River sturgeon in 1953-56 (Sunde 1961), 1977-78 (Sopuck 1987) and 1987-87. All calculations for 1953-56 and all regressions of age versus fork length are based on data grouped in age intervals of 3 years each. All other calculations are based on data from individual fish.

Parameter	1953-1956	1977-1978	1987-1988
Mesh Sizes Used (mm)	305	254-330	330
Sample Size	735	284	188
Mean Fork Length (mm)	1159	1116	1239
Mean Round Weight (g)	13208	11989	16173
Mean Age (years)	36.8	27.7	35.8
Mean Condition Factor	0.815	0.826	0.814
Regression of ln(FL) vs. ln(W)			
Slope	3.082	3.153	3.010
Y-intercept	-12.243	-12.785	-11.798
r squared	0.994	0.910	0.860
No. of observations	23	284	188
Regression of Age vs Fork Length			
Slope (mm/year)	8.1	15.4	9.4
Y-intercept (mm)	864	694	907
r squared	0.914	0.986	0.981
Ages included	19-45	19-45	19-45

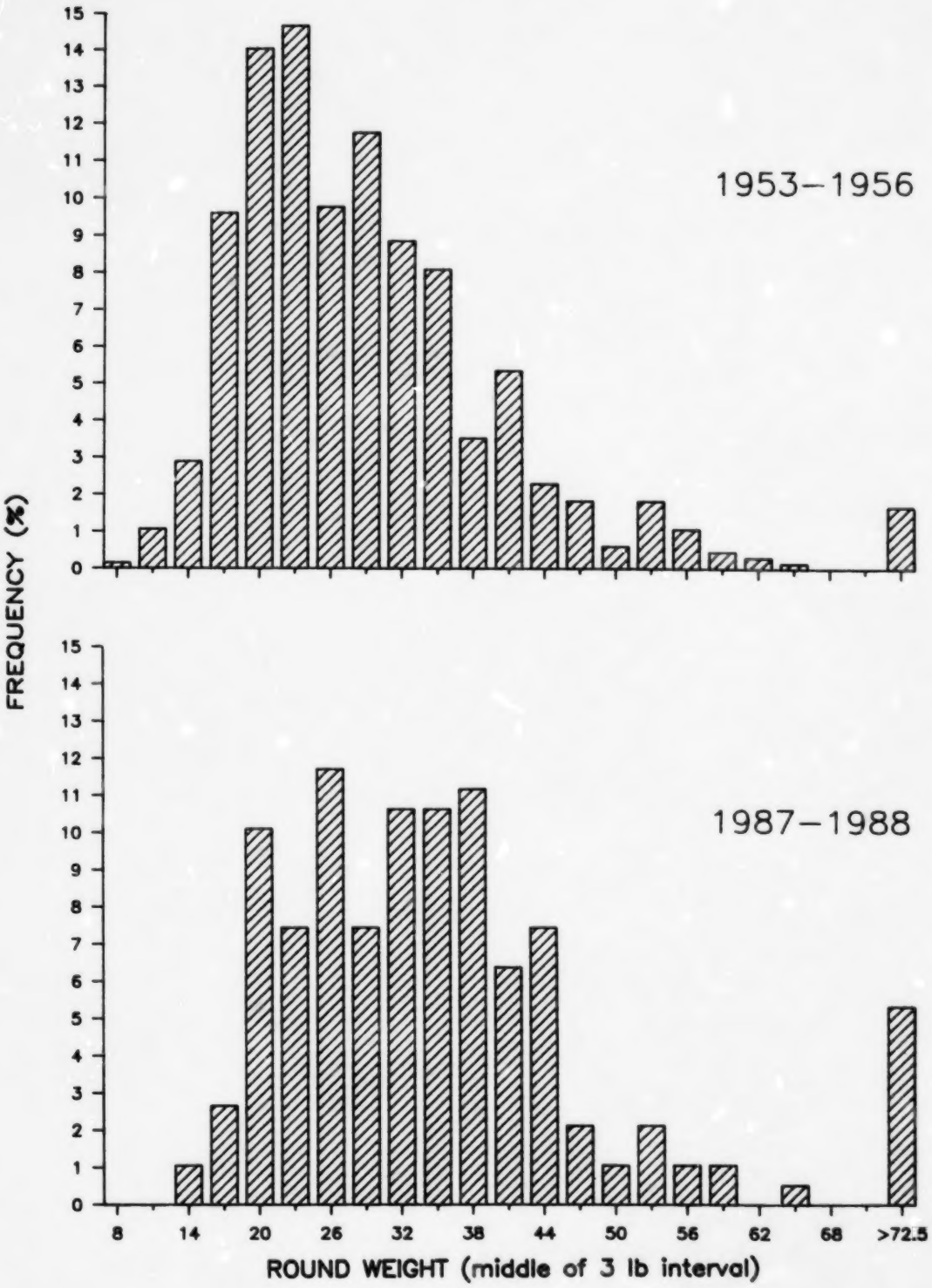

Fig. 11. Weight frequency distribution of sturgeon sampled from the Sipiwesk Lake commercial fishery in 1953 to 1956 (Sunde 1961) and in 1987 to 1988.

trends are exhibited in the record of mean dressed weight of commercially marketed sturgeon in the 1950's and 1980's (Fig. 12).

Commerical Harvest

Whereas in the past the Nelson River commercial sturgeon fishery always collapsed after at most ten years of continuous fishing, the present fishery shows uninterrupted production for the past nineteen years. This fact alone suggests that the levels of exploitation which allow for a sustained yield have not been exceeded by the present fishery.

The records of the commercial sturgeon harvest for the 1970-1987 period (Table 2) show that 83% of the total production was taken in the management zones #2 an #3, which comprise the Sipiwesk Lake area of the Nelson River. The present fishing regulations limit the annual catch in this area to 3525 kg. This quota is very similar to the recommendations given by Sunde (1961) who estimated that the Sipiwesk Lake area can be expected to produce a total sustained yield of approximately 3400 kg per year.

Between 1970 and 1987, the average annual harvest in the Sipiwesk Lake area was 2688 kg, which is considerably less than the estimated sustained yield or the catch quota assigned to the area. Even though the results presented in this report suggest that the present levels of exploitation are not excessive, it is impossible to predict the impact that the full exploitation of the quota might have on the sturgeon stocks in Sipiwesk Lake. Until such data can be obtained, it

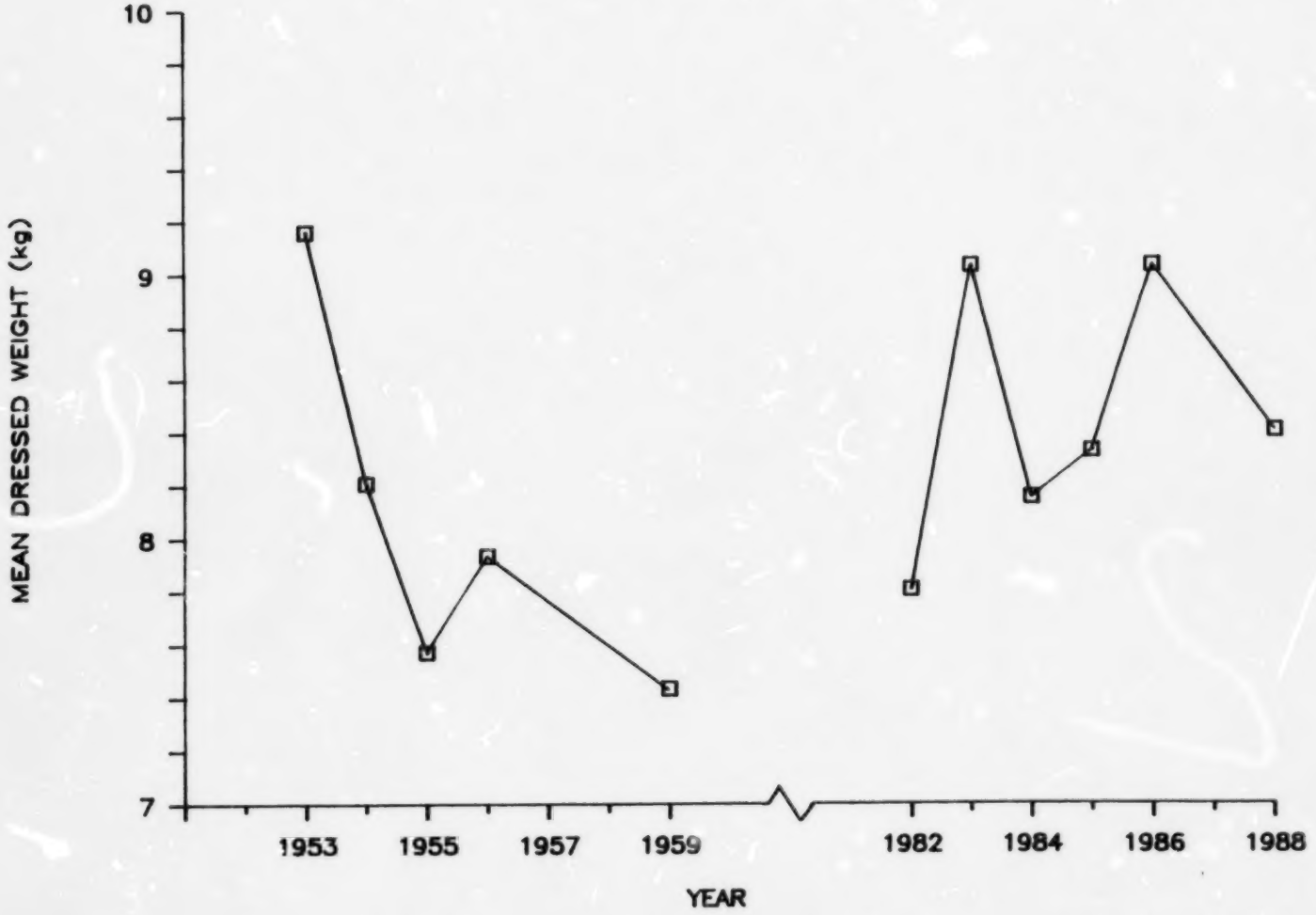

Fig. 12. Mean dressed weight of sturgeon caught by commercial fishermen in the Sipiwesk Lake area (management zones #2 and #3) in the 1950's and 1980's. The 1953 to 1959 data are from Sunde (1961) and the 1982 to 1988 data comes from records kept at the Wabowden fish plant.

is suggested that the present quotas for the management zones #2 and #3 remain unchanged.

In the management zones #1, #4 and #5, the present fishing regulations limit the annual sturgeon catch to a total of 4700 kg for the three zones. This is considerably more than the combined annual sustained yield of 1100 kg estimated for these areas by Sunde (1961). Despite the excessive quota, the average combined harvest in the three zones between 1970 and 1987 was only 543 kg per year (Table 2). As this harvest seems to be decreasing even more in the recent years (an annual average of 141 kg between 1983 and 1987), it is probable that the sturgeon populations in zones #1, #4 and #5 are in danger of becoming extinct. It is recommended that these zones be closed to sturgeon fishing until it can be shown that the stocks have recuperated sufficiently to withstand commercial exploitation. Because of the very small amounts of sturgeon harvested presently in zones #1, #4 and #5, the closure of these fisheries would have a minimal impact on the income of the commercial fishermen involved. On the other hand, the impact of the closure on the survival of the remaining sturgeon populations in these zones could prove to be quite significant.

RECOMMENDATIONS

1. The present commercial sturgeon fishing regulations for management zones #2 and #3 should remain unchanged.

2. Management zones #1, #4 and #5 should be closed to commercial sturgeon fishing in order to provide maximum protection for the remaining stocks.

3. Sturgeon stocks in mangement zones #2 and #3 should be monitored through annual sampling of the commercial catch. Commercial fishermen should be encouraged to participate in the monitoring program by collecting pectoral spines from all the sturgeon caught in order to increase the sample size for age frequency distribution. In addition, the cooperation of the fishermen in keeping records of their catches per unit of effort would provide the fisheries managers with useful information about changes in the sturgeon population size.

4. Domestic fishing for sturgeon in the Sipiwesk Lake area should be allowed to continue under the existing permit system. Mesh size restrictions and fishing season regulations should be the same as for the commercial fishery. These regulations should be closely enforced, especially during the spawning season. Immediate effort should be made to monitor the total domestic sturgeon harvest and to determine the impact of domestic

fishing on the sturgeon stocks of Sipiwesk Lake.

5. Because of the vulnerability of lake sturgeon to overexploitation and habitat alterations and the overall decline in sturgeon stocks throughout Manitoba, increased efforts should be expended in studying the species in areas such as the Nelson River, where it still occurs in relative abundance. Such studies should be designed to allow for the long term management of lake sturgeon stocks in the province and to prevent the eventual extirpation of the species.

ACKOWLEDGMENTS

I would like to thank L. Mohr, J. Christianson and B. Cherepak for participating in the data collection. The cooperation and assistance of A. Jonasson, W. Skulmoski, G. Chartrand and other commercial fishermen from Wabowden was greatly appreciated. A. Derksen, J. F. O'Connor, W. Lysack and D. Cook provided valuable guidance and editorial comments in the preparation of this report. Finally, I am grateful to J. Forte for typing this manuscript.

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APPENDICES

Appendix 1. Raw data for sturgeon caught by commercial fishermen in Sipiwesk Lake in 1987.

Fish Number	Date Sampled	Round Weight (g)	Fork Length (mm)	Sex	Maturity	Age	Condition Factor
1	June 17	17275	1320	F	Mat	39	0.751
2	June 17	18200	1270	F	Mat	26	0.889
3	June 17	17650	1290	M	Mat	40	0.822
4	June 17	17140	1230	M	Mat	38	0.921
5	June 17	17525	1295	M	Mat	44	0.807
6	June 17	8575	1085	M	Mat	35	0.671
7	June 17	11010	1070	M	Mat	29	0.899
8	June 17	14825	1190	F	Mat	37	0.880
9	June 17	8375	1030	M	Mat	21	0.766
10	June 17	10550	1130	M	Mat	32	0.731
11	June 17	16400	1310	F	Mat	40	0.730
12	June 17	18825	1300	M	Mat	37	0.857
13	June 17	12350	1100	F	Mat	36	0.928
14	June 17	11110	1145	M	Mat	34	0.740
15	June 18	16750	1270	F	Mat	48	0.818
16	June 18	15100	1090	F	Mat	28	1.166
17	June 18	13850	1220	F	Mat	21	0.763
18	June 18	18875	1330	F	Mat	47	0.802
19	June 18	12025	1230	F	Mat	38	0.646
20	June 18	27100	1385	F	Mat	48	1.020
21	June 18	9075	1030	M	Mat	25	0.830
22	June 18	18475	1290	F	Mat	34	0.861
23	June 18	20500	1275	M	Mat	47	0.989
24	June 18	45000	1540	F	Mat	82	1.232
25	June 18	11800	1170	M	Mat	32	0.737
26	June 22	14700	1115	F	Mat	27	1.060
27	June 22	13360	1140	F	Mat	38	0.902
28	June 22	12725	1145	M	Mat	51	0.848
29	June 22	20310	1315	F	Mat	41	0.893
30	June 22	16525	1275	F	Mat	42	0.797
31	June 22	12100	1105	M	Mat	31	0.897
32	June 22	38215	1535	F	Mat	66	1.057
33	June 22	17175	1220	F	Mat	38	0.946
34	June 22	16715	1285	M	Mat	39	0.788
35	June 22	23345	1410	F	Mat	39	0.833
36	June 22	10650	1140	M	Mat	42	0.719
37	June 22	10610	1100	M	Mat	26	0.797
38	June 22	17280	1295	F	Mat	39	0.796
39	June 22	20275	1340	F	Mat	32	0.843
40	June 22	17275	1270	F	Mat	45	0.843

Appendix 1. continued.

Fish Number	Date Sampled	Round Weight (g)	Fork Length (mm)	Sex	Maturity	Age	Condition Factor
41	June 22	9200	1065	M	Mat	29	0.762
42	June 22	9240	1085	M	Mat	28	0.723
43	June 22	12280	1030	M	Mat	30	1.124
44	June 22	9050	1010	M	Mat	21	0.878
45	June 22	10280	1095	M	Mat	29	0.783
46	June 22	15700	1290	M	Mat	35	0.731
47	June 22	16870	1230	F	Mat	29	0.907
48	June 22	18430	1325	F	Mat	39	0.792
49	June 22	5740	860	?	?	12	0.902
50	June 26	18800	1325	M	?	36	0.808
51	June 26	19000	1290	F	?	37	0.885
52	June 26	22550	1310	F	?	43	1.003
53	June 26	21480	1340	F	?	38	0.893
54	June 26	39850	1730	F	?	87	0.770
55	June 26	29250	1470	F	?	41	0.921
56	June 26	15550	1200	F	?	33	0.900
57	June 26	16750	1310	F	?	40	0.745
58	June 26	16680	1300	F	?	38	0.759
59	June 26	7600	1050	M	?	34	0.657
60	June 26	20100	1310	F	?	51	0.894
61	June 26	12360	1120	F	?	27	0.880
62	June 26	14500	1350	F	?	44	0.589
63	June 26	10050	1020	F	?	27	0.947
64	June 26	9000	1060	F	?	28	0.756
65	June 27	26700	1500	F	?	48	0.791
66	June 27	12400	1150	M	?	32	0.815
67	June 27	14600	1390	M	?	36	0.544
68	June 27	14600	1390	F	?	38	0.544
69	June 27	12450	1160	M	?	25	0.798
70	June 27	12350	1140	M	?	31	0.834
71	June 30	25550	1500	F	Mat	46	0.757
72	June 30	11575	1090	M	Mat	21	0.894
73	June 30	11725	1165	M	Mat	29	0.742
74	June 30	15040	1210	M	Mat	27	0.849
75	June 30	15725	1185	F	Mat	30	0.945
76	June 30	12470	1150	M	Mat	22	0.820
77	June 30	17280	1260	F	Mat	31	0.864
78	June 30	12480	1130	F	Mat	31	0.865
79	June 30	11140	1095	M	Mat	27	0.848
80	June 30	9240	1020	M	Mat	27	0.871
Total		1285255	97995			2891	67.062
Mean		16066	1225			36.1	0.838

Appendix 2. Raw data for sturgeon caught by commercial fishermen in Sipiwesk Lake in 1988. Fork lengths are calculated from total lengths using FL = 0.9205*TL + 8.79.

Fish Number	Date Sampled	Round Weight (g)	Total Length (mm)	Fork Length (mm)	Sex	Maturity	Age	Condition Factor
1	June 17	14500	1330	1233	F	Mat	37	0.774
2	June 17	11500	1230	1141	M	Mat	40	0.774
3	June 17	10500	1230	1141	M	Mat	26	0.707
4	June 17	9000	1210	1123	M	Mat	34	0.636
5	June 17	7000	1140	1058	M	Mat	26	0.591
6	June 17	8500	1180	1095	M	Mat	26	0.648
7	June 17	21300	1550	1436	F	Mat	34	0.720
8	June 17	15900	1410	1307	F	Mat	40	0.713
9	June 17	14400	1390	1288	M	Mat	29	0.674
10	June 17	9000	1230	1141	M	Mat	27	0.606
11	June 17	16900	1340	1242	F	Mat	39	0.882
12	June 17	9400	1190	1104	M	Mat	27	0.698
13	June 17	19700	1440	1334	F	Mat	29	0.829
14	June 17	11700	1260	1169	M	Mat	34	0.733
15	June 17	20100	1430	1325	F	Mat	40	0.864
16	June 17	11900	1330	1233	M	Mat	29	0.635
17	June 17	7800	1190	1104	F	Imm	29	0.579
18	June 17	17400	1400	1297	M	Mat	32	0.797
19	June 17	21800	1500	1389	F	Mat	39	0.813
20	June 17	24200	1510	1399	F	Mat	42	0.884
21	June 17	34500	1780	1647	F	Mat	66	0.772
22	June 17	34100	1810	1675	F	Mat	73	0.726
23	June 17	33100	1740	1610	F	Mat	45	0.793
24	June 19	19400	1420	1316	F	Mat	41	0.851
25	June 19	11200	1270	1178	F	Imm	31	0.686
26	June 19	16300	1410	1307	F	Mat	36	0.731
27	June 19	14700	1340	1242	F	Mat	32	0.767
28	June 19	14900	1320	1224	F	Mat	37	0.813
29	June 19	13900	1290	1196	F	Mat	37	0.812
30	June 19	12200	1240	1150	F	Mat	26	0.802
31	June 19	19300	1400	1297	F	Mat	39	0.884
32	June 19	9700	1210	1123	M	Mat	25	0.686
33	June 19	17600	1380	1279	F	Imm	37	0.841
34	June 19	13800	1370	1270	F	Mat	32	0.674
35	June 19	11800	1200	1113	M	Mat	29	0.855
36	June 19	10200	1180	1095	F	Imm	27	0.777
37	June 19	16000	1400	1297	F	Mat	40	0.733
38	June 19	20600	1490	1380	F	Mat	42	0.783
39	June 19	10700	1220	1132	M	Mat	36	0.738
40	June 19	16050	1320	1224	F	Mat	40	0.876

Appendix 2. continued.

Fish Number	Date Sampled	Round Weight (g)	Total Length (mm)	Fork Length (mm)	Sex	Maturity	Age	Condition Factor
41	June 19	11200	1220	1132	M	Mat	30	0.773
42	June 19	14500	1290	1196	M	Mat	29	0.847
43	June 19	10700	1240	1150	M	Mat	19	0.703
44	June 19	15900	1380	1279	F	Mat	27	0.760
45	June 19	35000	1760	1629	F	Mat	66	0.810
46	June 25	15100	1320	1224	M	?	27	0.824
47	June 25	19300	1400	1297	F	?	41	0.884
48	June 25	9700	1190	1104	M	?	26	0.721
49	June 25	9100	1180	1095	M	?	33	0.693
50	June 25	9500	1220	1132	M	?	32	0.655
51	June 25	16500	1350	1251	F	Mat	36	0.842
52	June 25	16500	1370	1270	F	?	42	0.806
53	June 25	15600	1370	1270	F	?	41	0.762
54	June 25	16300	1400	1297	F	Mat	37	0.746
55	June 25	15400	1400	1297	F	?	48	0.705
56	June 25	13800	1300	1205	M	?	42	0.788
57	June 25	19900	1470	1362	F	?	28	0.788
58	June 25	24200	1490	1380	F	?	52	0.920
59	June 25	18800	1470	1362	F	?	38	0.744
60	June 25	17700	1400	1297	F	?	27	0.810
61	June 25	21000	1450	1343	F	?	36	0.866
62	June 25	20400	1370	1270	F	?	28	0.996
#63	June 25	12200	970	902	M	?	32	1.664
64	June 25	14700	1260	1169	M	?	41	0.921
65	June 25	17200	1470	1362	F	?	33	0.681
66	June 25	38900	1910	1767	?	?	72	0.705
67	June 26	18800	1460	1353	F	?	26	0.760
#68	June 26	35600	1140	1058	F	?	34	3.005
69	June 26	13800	1180	1095	M	?	31	1.051
70	June 26	7700	1140	1058	M	?	38	0.650
71	June 26	10900	1170	1086	F	?	27	0.852
72	June 26	9500	1120	1040	F	?	13	0.845
73	June 26	17000	1370	1270	F	?	28	0.830
74	June 26	12000	1190	1104	F	?	30	0.891
75	June 26	18800	1320	1224	F	?	28	1.026
76	June 26	18100	1440	1334	F	?	36	0.762
77	June 26	14900	1350	1251	F	?	45	0.760
78	June 26	14700	1260	1169	F	?	30	0.921
79	June 26	8400	1110	1031	M	?	23	0.768
80	June 26	13300	1270	1178	M	?	36	0.814

not used in growth calculations because of high condition factor

Appendix 2. continued.

Fish Number	Date Sampled	Round Weight (g)	Total Length (mm)	Fork Length (mm)	Sex	Maturity	Age	Condition Factor
81	June 26	16300	1330	1233	F	?	33	0.870
82	June 26	14300	1330	1233	M	?	46	0.763
83	June 26	15400	1370	1270	F	?	45	0.752
84	June 26	10200	1190	1104	F	?	27	0.758
85	June 26	15600	1310	1215	M	?	26	0.871
86	June 26	14000	1310	1215	F	?	33	0.781
87	June 26	13800	1300	1205	F	?	26	0.788
88	June 26	17000	1170	1086	F	?	30	1.328
89	June 26	13600	1350	1251	F	?	27	0.694
90	June 26	13100	1250	1159	F	?	36	0.841
91	June 26	17200	1370	1270	F	?	35	0.840
92	June 26	12200	1270	1178	F	?	44	0.747
93	June 26	16500	1490	1380	F	?	46	0.627
94	June 26	13100	1320	1224	F	?	35	0.715
95	June 26	13600	1190	1104	M	?	28	1.010
96	June 26	7700	1140	1058	F	?	28	0.650
97	June 26	13000	1270	1178	M	?	24	0.796
98	June 26	19900	1450	1343	F	?	33	0.821
99	June 26	9100	1140	1058	F	?	25	0.768
100	June 26	19000	1470	1362	F	?	37	0.752
101	June 26	20100	1450	1343	F	?	40	0.829
102	June 26	40200	1730	1601	F	?	75	0.979
103	June 26	41200	1800	1666	F	?	76	0.892
104	June 26	23500	1420	1316	F	?	40	1.031
105	June 26	10200	1120	1040	M	?	25	0.908
106	June 26	13100	1280	1187	F	?	38	0.783
107	July 2	9500	1180	1095	M	?	27	0.724
108	July 2	15400	1270	1178	M	?	24	0.943
109	July 2	25800	1520	1408	F	?	49	0.924
110	July 2	24400	1520	1408	F	?	37	0.874
Total		1803150	147760	136976			3913	90.561
Mean		16392	1343	1245			35.6	0.823